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Professor Joshua Lederberg
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Dear Josh:

Your little note on cost analysis of genetic disease is very stimulating. Obviously, there is a tremendous amount of approximation in the figures; in particular, the implicit figure of 100 billion dollars a year as the avoidable costs of genetic disease is, as you note, pure guess. Still, it does suggest reasonable orders of magnitude. I found some trouble in reading your calculations because you shift between two ways of looking at costs. One is as a flow, that is, dollars per year. The other is as a stock, and this is what is usually meant when you speak of present value. Either approach is legitimate, providing one is consistent. However, I think the expression of costs in terms of flows is easier to understand because one can compare it with a flow figure that we are all accustomed to, namely, gross national product. The capitalized value of future gross national products, though perfectly meaningful, is not as familiar to our minds.

With this in mind, it is clear that if the genetic costs took place immediately, there really would be nothing more to calculate. Your figure amounts to 100 billion dollars per rad for the total population of the United States. Presumably this figure goes up over time as people become more productive, but it is also true that the GNP goes up for the same reason. Hence a comparison of 100 billion dollars per rad with a GNP of a trillion dollars is itself a kind of a sensible and meaningful comparison.

In this case, the situation is complicated by the fact that the genetic cost is not a steady flow but takes some time to come into equilibrium. Until the time path is worked out (I'm impressed by the idea that you can work it out), there is little explicit that can be said. The principle I go on is the following. Take the genetic costs as a time stream. Take account of increasing productivity; one could multiply future costs by an anti-discount factor

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P.S. I would not neglect population growth for the GNP growth relevant to this discussion. An increment in mutation rate would have a linear effect on the incidence (not absolute numbers) of mutant defects thereafter.

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rising at the rate of 2% per annum. Discount the resulting costs back to the present at 6%. As you say, the cost a hundred years hence will not amount to much of anything, but presumably a considerable burden of the genetic costs will be occurring in the near future. The result is a stock figure, the present value of all future costs. I would then take 4% (that is, 6%, the discount rate, less 2%, the annual growth and productivity) as a measure of the steady stream equivalent of the present value. This figure could profitably compare with a trillion dollars. We are saying, in effect, that if we take a stream which is 4% of the present value of today and rises at 2% per annum, we have a stream whose discounted value is the same as that of the huge genetic costs. Since it is a smoother function of time, it is one we can more easily compare with the successive GNP's which presumably will also grow ~~to~~ 2% at
(neglecting population growth, of course).

I hope this makes sense. I look forward to seeing you this summer.

As ever,

Kenneth J. Arrow

KJA:hlw